Collaborative Research: NRI: INT: Customizable Lower-Limb Wearable Robot using Soft-Wearable Sensor to Assist Occupational Workers

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Goal: Personalization in lower-limb assistive wearable robots using human-in-the-loop (HIL) optimization to reduce the physical effort in intensive activities, thereby reducing injury.

Challenges:

1) Inaccurate, slow physical effort estimation.

2) Error-prone, burdensome biofeedback sensors.

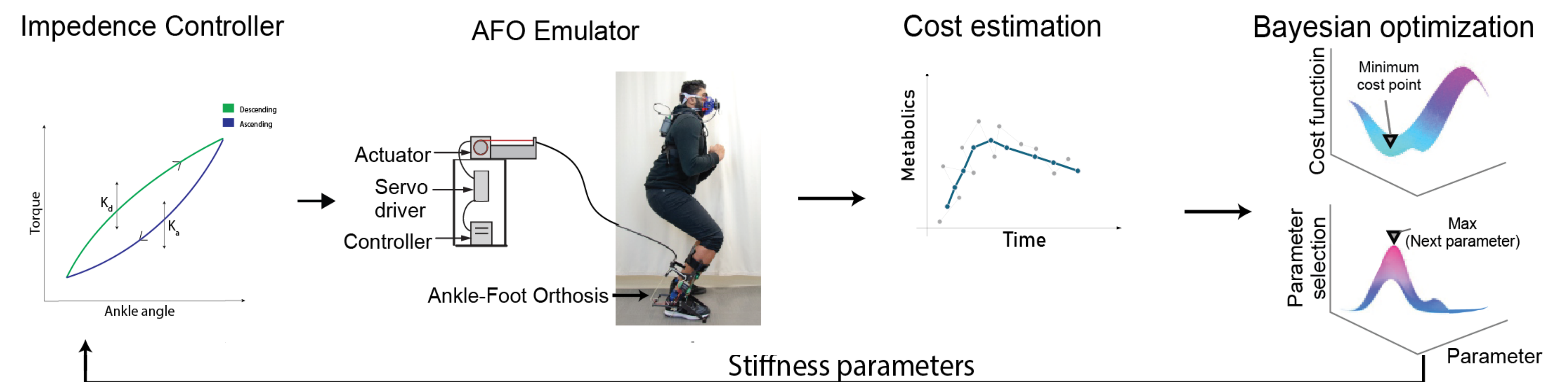3) Unavailable personalized evaluation for physically intensive activities.

Fig. 1 Human-in-the-loop (HIL) optimization for squatting.

Aim 1: Fast HIL optimization

For time-efficient estimation of the user's physical effort, to be used as the cost function to be minimized when optimizing assistance.

Aim 2: Soft wearable electronics

For offering accurate, motion artifact-controlled recording of physiological signals, including ECG, heart rates, EMG, blood oxygen saturation, and pressure.

Aim 3: Integration & Evaluation

For seamless integration of soft sensors with a robotic ankle exoskeleton to provide personalized assistance using sensory biofeedback.

Impact: Science & Technology, Applications

- Efficient physical effort estimation for customizing assistance to assist occupational workers.

- Wireless, soft wearable electronics, applicable for diagnosis and monitoring.

- Ergonomic and systematic evaluation, potential for safety hazard diagnoses.
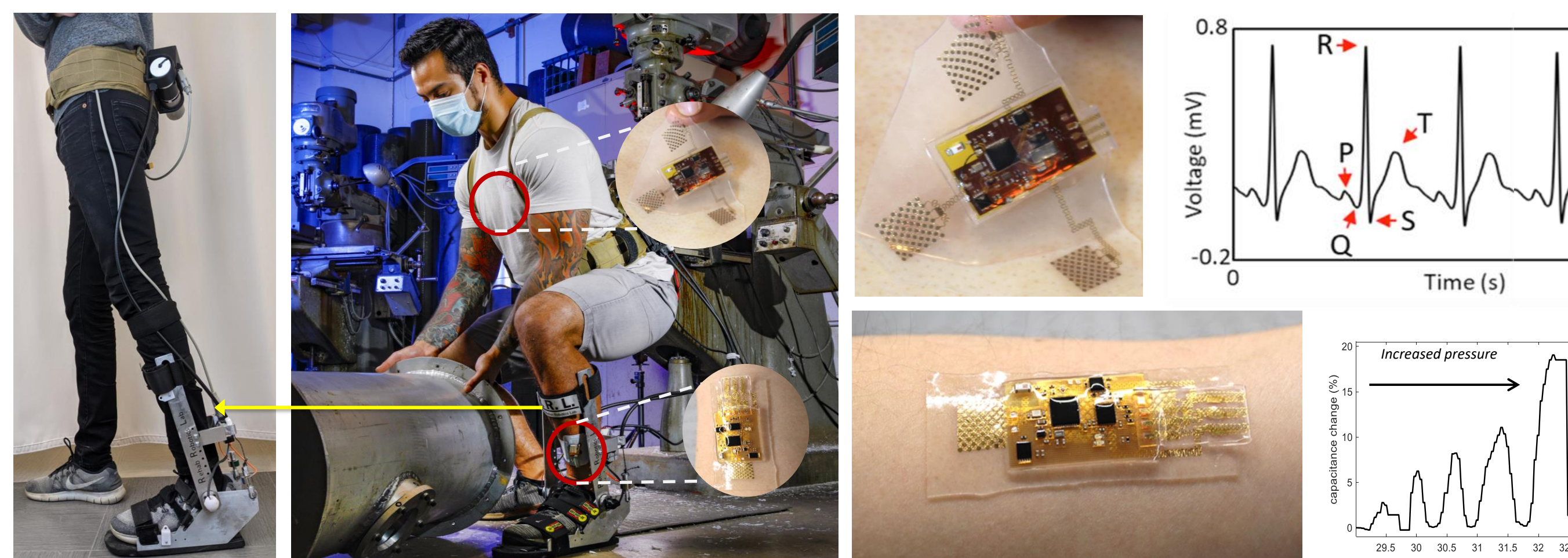

Fig. 2 Customized exoskeleton example (left) and Soft wearable electronics (right).

Impact: Education

- Integrates research & education via projects with improved infrastructure

- Broadening participation in STEM

- "Soft wearable electronics" for underrepresented students

Fig 3. Class project (Top) K-12 in research (Bottom).